

CLAIMS

1. An extracorporeal support system coupled to a blood circulation, comprising:

an extracorporeal support apparatus;

an arterial circulation support catheter with a proximal end coupled to the extracorporeal support apparatus and a distal end inserted into the blood circulation, the arterial circulation support catheter including a blood lumen and a vent lumen with a distal end that crosses the aortic valve into the left ventricle for direct venting of the left ventricle through the vent lumen;

an arterial circulation support catheter occluding member positioned in an interior or at an exterior of the arterial circulation support catheter;

a venous circulation support catheter with a proximal end coupled to the extracorporeal support apparatus and a distal end inserted into the blood circulation, the venous circulation support catheter including a blood lumen; and

a venous circulation support catheter occluding member to occlude the superior vena cava and the inferior vena cava, the venous circulation support catheter occluding member being positioned in an interior or at an exterior of the venous circulation support catheter.

2. The system of claim 1, wherein the extracorporeal support apparatus includes an outlet port for the delivery of re-oxygenated blood to the blood circulation, and an inlet port for receiving blood from the blood circulation.

3. The system of claim 2, wherein the arterial circulation support catheter proximal end is coupled to the outlet port, and the venous circulation support catheter proximal end is coupled to the inlet port.

2. The system of claim 1, further comprising:

an arterial circulatory support occluding member lumen coupled to the arterial circulatory support occluding member and positioned in the arterial circulation support catheter.

5

3. The system of claim 1 and 2, wherein the arterial circulatory support occluding member is slideably positioned in the blood lumen or the arterial circulation support occluding member lumen.

4. The system of claim 1, wherein the arterial circulation support catheter occluding member is a clamp.

10

5. The system of claim 1, further comprising:

a venous circulation support catheter occluding member lumen coupled to the venous circulation support catheter occluding member and positioned in the venous circulation support catheter.

15

6. The system of claims 1 and 5, wherein the venous circulation support catheter occluding member is slideably positioned in the venous circulation support catheter blood lumen or the venous circulation support catheter occluding member lumen.

7. The system of claim 1, wherein the vent lumen provides infusion capability into the left ventricle.

20

8. The system of claim 1, wherein the arterial circulation support catheter occluding member is a balloon.

9. The system of claim 1, wherein the arterial circulation support catheter includes two occluding members.

10. The system of claim 1, wherein the arterial circulation support catheter further comprises:

5 an infusion lumen including a distal end that introduces an infusion medium into the aortic root, wherein the infusion lumen is positioned in the interior or at the exterior of the arterial circulation support catheter.

11. The system of claim 10, wherein the infusion lumen is positioned in the blood lumen.

10 12. The system of claim 10, wherein the infusion lumen is positioned in the arterial circulation support catheter adjacent to the blood lumen.

13. The system of claim 10, wherein the infusion lumen introduces an infusion medium into the aortic root and vents mediums from the aortic root simultaneously or at alternative times.

14. The system of claim 1, wherein the arterial circulation support catheter further comprises:

20 an interventional lumen including a distal end that introduces a diagnostic or therapeutic device into the blood circulation, wherein the interventional lumen is positioned in the interior or at the exterior of the arterial circulation support catheter.

15. The system of claim 14, wherein the interventional lumen is positioned in the blood lumen.

16. The system of claim 14, wherein the infusion lumen is positioned in the arterial circulation support catheter adjacent to the blood lumen.

17. The system of claim 1, wherein the extracorporeal support apparatus includes a device to re-oxygenate blood.

5 18. The system of claim 17, wherein the extracorporeal support apparatus further includes a temperature control device to cool the heart and assist in stopping the heart from beating, and subsequently heat the heart to assist in initiating the heart to beat.

10 19. The system of claim 18, wherein the further comprising: a fibrillation and defibrillation apparatus coupled to the heart.

20. The system of claim 1, wherein the arterial circulatory support catheter occluding member is positioned in the ascending aorta.

21. The system of claim 10, wherein the infusion medium is a cardio-active agent.

15 22. The system of claim 10, wherein the infusion medium is one or more contrast agents.

23. The system of claim 10, wherein the infusion medium is an inotropic agent.

20 24. The system of claim 1, wherein the venous circulation support catheter occluding member includes two occluding members.

32. The system of claim 25, wherein the interventional lumen is positioned in the blood lumen.

5 33. The system of claim 25, wherein the interventional lumen is positioned in the venous circulation support catheter adjacent to the blood lumen.

34. The system of claim 30, wherein the infusion medium is a cardio-active agent.

10 35. The system of claim 30, wherein the infusion medium is one or more contrast agents.

36. The system of claim 30, wherein the infusion medium is an ionotropic agent.

37. The system of claim 31, wherein the interventional lumen introduces a therapeutic device.

15 38. The system of claim 31, wherein the interventional lumen permits balloon valvuloplasty.

39. An extracorporeal support system coupled to a blood circulation, comprising:

an extracorporeal support apparatus;

20 an arterial circulation support catheter including a blood lumen with a proximal end coupled to the extracorporeal support apparatus and a distal end inserted into the blood circulation;

an arterial circulation support catheter occluding member positioned in an interior or at an exterior of the arterial circulation support catheter;

5 a vent lumen with a distal end positioned in the left ventricle and provide direct venting of the left ventricle, wherein the vent lumen is positioned in the interior or the exterior of the arterial circulatory support lumen.

a venous circulation support catheter including a blood lumen with a proximal end coupled to the extracorporeal support apparatus and a distal end inserted into the blood circulation; and

10 a venous circulation support catheter occluding member to occlude the superior vena cava and the inferior vena cava, the venous circulation support catheter occluding member being positioned in an interior or at an exterior of the venous circulation support catheter.

15 2. The system of claim 39, wherein the extracorporeal support apparatus includes an outlet port for the delivery of re-oxygenated blood to the blood circulation, and an inlet port for receiving blood from the blood circulation.

3. The system of claim 2, wherein the arterial circulation support catheter proximal end is coupled to the outlet port, and the venous circulation support catheter proximal end is coupled to the inlet port.

20 40. The system of claim 39, wherein the distal end of the vent lumen crosses the aortic valve.

41. The system of claim 39, wherein the vent lumen is positioned in the arterial circulation support catheter blood lumen.

42. A method for venting a left ventricle of a heart, comprising:

providing an extracorporeal circulation support system including an extracorporeal support apparatus, a venous circulation support catheter, an arterial circulation support catheter and a vent lumen;

5 introducing the arterial circulation support catheter into a blood circulation;

introducing the venous circulation support catheter into the blood circulation;

positioning a vent lumen distal end into a left ventricle of the heart; and venting the left ventricle through the vent lumen.

10 43. The method of claim 42, wherein a proximal end of the arterial circulation support catheter is coupled to an outlet port of the extracorporeal support device.

15 44. The method of claim 43, wherein a proximal end of the venous circulation support catheter is coupled to an inlet port of the extracorporeal support device.

45. The method of claim 42, wherein the left ventricle is directly vented through the vent lumen.

add a1